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# (12) United States Patent Major et al.

# (54) METHOD, APPARATUS AND SYSTEM FOR AUTOMATED SPINE LABELING

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See application file for complete search history.

# (56) References Cited

#### U.S. PATENT DOCUMENTS

2011/0064291 A1 3/2011 Kelm et al. OTHER PUBLICATIONS

Roberts et al., "Automatic Segmentation of Lumbar Vertebrae on Digitised Radiographs Using Linked Active Appearance Models," Proceedings of Medical Image Understanding and Analysis, vol. 1, Jan. 1, 2006, pp. 120-124.\*

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(Continued)

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### (57) ABSTRACT

A method, an apparatus, and a system label one or more parts of a spine in an image, in particular a computed tomography (CT) image, of a human or animal body, and in order to achieve a reliable spine labeling and a high throughput of images, match a model of a spine segment with segments of the spine in the image by starting matching the model of a spine segment with an initial segment of the spine in the image, wherein the initial segment of the spine in the image is located at an initial position along the spine in the image, and continue to match the model of a spine segment with one or more further segments of the spine in the image, wherein the further segments of the spine in the image are located at positions farther along the spine in the image.

# 15 Claims, 4 Drawing Sheets

